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Project Summary

Physical/Chemical Treatment of Coke Plant Wastewater

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The full report documents a pilot-plant study of the use of advanced waste treatment methods in upgrading metallurgical cokemaking wastewaters to Best Available Technology (BAT) levels. Mobile treatment units, operable at a flow rate of 19 l/min, were used. Two physical/chemical treatment trains were studied: (a) alkaline-chlorination/filtration/activated-carbon, and (b) alkaline-chlorination/sodium-bisulfite-dechlorination/filtration. For each treatment studied, samples (including toxic pollutants) and operational data were obtained for later use in assessing and comparing treatment adequacy. Chlorination was effective in consistently reducing pollutant concentrations to below BAT levels, except for total cyanide. Filtration was essential as an adjunct to alkaline chlorination for post-treatment suspended solids removal. Activated carbon and sodium bisulfite were efficient in removing excess chlorine resulting from treatment by alkaline chlorination, although carbon was more effective in removing organic priority pollutants.

This Project Summary was developed by EPA's Industrial Environmental Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The purpose of this project was to investigate the effectiveness of selected advanced waste treatment technologies for treating By-Product Cokemaking Subcategory wastewater to Best Available Technology (BAT) Economically Achievable levels. The wastewaters generated from the by-product recovery process include excess ammonia liquors, benzol plant wastes, final cooler wastewaters, desulfurizer wastes, scrubber blowdown, and tar decanter wastewaters. Pollutants contained in these wastewaters typically include suspended solids, ammonia, phenolic compounds, cyanide, sulfide, oil and greases, and many toxic pollutants.

The investigation was conducted using the U.S. Environmental Protection Agency's (EPA's) mobile physical/chemical treatment system. This pilot plant is housed in two semi-trailer vans and includes four chamber rapid mix tanks (alkaline chlorination) with a chemical feed system, a dual media filter skid, and activated carbon columns.

The advanced waste treatment trains that were investigated on a pilot scale included:

1. ACL + FIL + AC
2. ACL + SBD + FIL

Key

AC:	activated carbon
ACL:	alkaline chlorination
FIL:	dual media filtration
SBD:	sodium bisulfite dechlorination

EP 1.89/2:

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In the first pilot treatment train, the coke plant pre-treated wastewater was passed through a two-stage alkaline chlorination process for cyanide, phenol, sulfide, thiocyanate and ammonia removal. The wastewater was then filtered for suspended solids removal and dechlorinated on activated carbon. The second treatment train again consisted of alkaline chlorination which was followed by sodium bisulfite dechlorination and dual media filtration.

Prior to conducting the pilot studies, in-depth bench tests were performed to obtain preliminary information on treatment feasibility, expected magnitude of treatment efficiency and optimum treatment train process element arrangement.

During the pilot study, samples were collected for both conventional and toxic pollutants. Operational data were also recorded on a daily basis to evaluate the effectiveness of the respective treatment trains. The pilot study results were evaluated using the three primary criteria listed below:

1. process and/or treatment train performance
2. capital and annualized costs
3. space requirements

The advanced wastewater treatment technologies evaluated would normally be applied to an effluent stream that met the 1977 Best Practicable (Control) Technology (BPT) requirements. However, during the study, pollutant levels were consistently higher than BPT levels because of pretreatment equipment problems.

Summary and Conclusions

Two physical/chemical treatment trains were investigated. Train 1 consisted of alkaline chlorination, filtration, and activated carbon. Train 2 consisted of alkaline chlorination, filtration, and sodium bisulfite dechlorination.

1. The results of the pilot program indicated that alkaline chlorination was effective in reducing influent concentrations of ammonia, oil and grease, phenol, sulfide, suspended solids, and thiocyanate to below future BAT levels. The presence of complexing agents in the coke plant effluent prevented complete oxidation of the cyanide by chlorine; as a result, BAT cyanide-T values could not be met consistently. An estimated capital cost of $711,000 and annualized cost of $17.47/3,785 liters ($17.47/1,000 gal.) would be realized for a 1,022 m^3/day (0.27 mgd) treatment facility, assuming current wastewater pollutant concentrations. If the proposed BAT system were applied to a waste stream that met BPT pollutant parameters, the annualized cost could be reduced to $9.26/3,785 liters ($9.26/1,000 gal.).
2. Filtration provided effective polishing of the alkaline chlorinated coke plant wastewater, removing 71 percent of the influent suspended solids. Suspended solids removal could be increased to 93 percent with the addition of 3 mg/l polymer. A 1,022 m^3/day (0.27 mgd) filtration system without polymer addition would have an estimated capital cost of $218,000, with an annualized cost of $0.48/3,785 liters ($0.48/1,000 gal.). A similar system with polymer addition would have a capital cost of $243,000 and an estimated annualized cost of $0.58/3,785 liters ($0.58/1,000 gal.).
3. Activated carbon and sodium bisulfite were investigated as dechlorinating agents. Activated carbon was found to consistently remove 95 percent of the incoming total chlorine. The treatment cost for a 1,022 m^3/day (0.27 mgd) activated carbon dechlorination system was estimated at $1,122,000 capital outlay with an annualized cost of $5.47/3,785 liters ($5.47/1,000 gal.). Sodium bisulfite provided 100 percent chlorine removal at a bisulfite:chlorine ratio of 2:1. A 1,022 m^3/day (0.27 mgd) sodium bisulfite dechlorination system has an estimated capital treatment equipment cost of $174,000 with an annualized cost of $0.98/3,785 liters ($0.98/1,000 gal.).
4. During the pilot study, 63 samples were analyzed for priority pollutants. The results concluded that the physical/chemical treatment trains investigated created several volatile organic priority pollutants. Train 1 technologies removed 73 percent of the volatile organic priority pollutants to non-detectable limits; Train 2 technologies were effective in treating only 17 percent of incoming volatile organic toxics to non-detectable levels. Semivolatile organics were all effectively reduced for Train 1. Train 2 also reduced all semivolatile organics to less than 100 μg/l except for naphthalene. The physical/chemical treatment trains removed only negligible concentrations of metals.

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The complete report, entitled "Physical/Chemical Treatment of Coke Plant Wastewater," (Order No. PB 81-206 021; Cost: $17.00, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
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